

**SWITCHMODE SERIES**

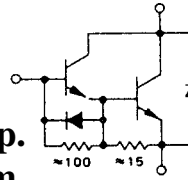
**NPN SILICON POWER DARLINGTON TRANSISTORS WITH BASE-EMITTER SPEEDUP DIODE**

The MJ10004 and MJ10005 darlington transistors are designed for high-voltage, high-speed, power switching in inductive circuits where fall time is critical. They are particularly suited for line operated switch-mode applications such as:

**FEATURES:**

- \*Continuous Collector Current -  $I_C = 20$  A
- \*Switching Regulators
- \*Inverters
- \*Solenoid and Relay Drivers
- \*Motor Controls

**Boca Semiconductor Corp.**  
<http://www.bocasemi.com>

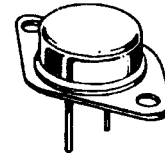


**NPN  
 MJ10004  
 MJ10005**

**20 AMPERE  
 POWER DARLINGTON  
 TRANSISTORS  
 350-400 VOLTS  
 175 WATTS**

**MAXIMUM RATINGS**

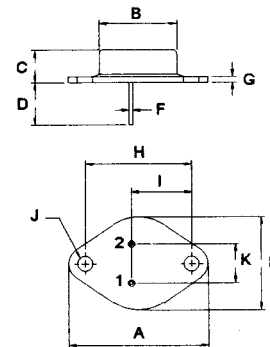
| Characteristic                                   | Symbol         | MJ10004      | MJ10005 | Unit          |
|--|----------------|--------------|---------|---------------|
| Collector-Emitter Voltage                        | $V_{CEV}$      | 450          | 500     | V             |
| Collector-Emitter Voltage                        | $V_{CEX(SUS)}$ | 400          | 450     | V             |
| Collector-Emitter Voltage                        | $V_{CEO(SUS)}$ | 350          | 400     | V             |
| Emitter-Base Voltage                             | $V_{EBO}$      | 8.0          |         | V             |
| Collector Current-Continuous                     | $I_C$          | 20           |         | A             |
| -Peak  | $I_{CM}$       | 30           |         |               |
| Base current                                     | $I_B$          | 2.5          |         | A             |
| Total Power Dissipation @ $T_C=25^\circ C$       | $P_D$          | 175          |         | W             |
| Derate above $25^\circ C$                        |                | 100          |         | W             |
|  |                | 1.0          |         | W/ $^\circ C$ |
| Operating and Storage Junction Temperature Range | $T_J, T_{STG}$ | - 65 to +200 |         | $^\circ C$    |



**TO-3**

**THERMAL CHARACTERISTICS**

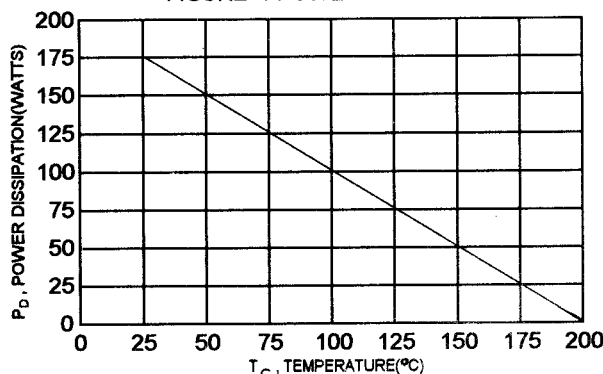
| Characteristic                      | Symbol          | Max | Unit         |
|-------------------------------------|-----------------|-----|--------------|
| Thermal Resistance Junction to Case | $R_{\theta jc}$ | 1.0 | $^\circ C/W$ |



PIN 1.BASE  
 2.EMITTER  
 COLLECTOR(CASE)

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | 38.75       | 39.96 |
| B   | 19.28       | 22.23 |
| C   | 7.96        | 9.28  |
| D   | 11.18       | 12.19 |
| E   | 25.20       | 26.67 |
| F   | 0.92        | 1.09  |
| G   | 1.38        | 1.62  |
| H   | 29.90       | 30.40 |
| I   | 16.64       | 17.30 |
| J   | 3.88        | 4.36  |
| K   | 10.67       | 11.18 |

**FIGURE -1 POWER DERATING**



**ELECTRICAL CHARACTERISTICS (  $T_C = 25^\circ\text{C}$  unless otherwise noted )**

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

**OFF CHARACTERISTICS**

|   |                    |                       |             |    |
|---|--------------------|-----------------------|-------------|----|
| Collector - Emitter Sustaining Voltage<br>( $I_C = 250\text{ mA}, I_B = 0, V_{\text{clamp}} = \text{Rate } V_{\text{CEO}}$ )  | MJ10004<br>MJ10005 | $V_{\text{CEO(sus)}}$ | 350<br>400  | V  |
| Collector Cutoff Current<br>( $V_{\text{CE}} = \text{Rated } V_{\text{CEV}}, R_{\text{BE}} = 50\text{ ohm}, T_C = 100^\circ\text{C}$ )  |                    | $I_{\text{CER}}$      | 5.0         | mA |
| Collector Cutoff Current<br>( $V_{\text{CEV}} = \text{Rated Value}, V_{\text{BE(off)}} = 1.5\text{ V}$ )<br>( $V_{\text{CEV}} = \text{Rated Value}, V_{\text{BE(off)}} = 1.5\text{ V}, T_C = 100^\circ\text{C}$ ) |                    | $I_{\text{CEV}}$      | 0.25<br>5.0 | mA |
| Emitter Cutoff Current<br>( $V_{\text{EB}} = 2.0\text{ V}, I_C = 0$ )   |                    | $I_{\text{EBO}}$      | 175         | mA |

**ON CHARACTERISTICS (1)**

|  |  |                      |          |                   |
|--|--|----------------------|----------|-------------------|
| DC Current Gain<br>( $I_C = 5.0\text{ A}, V_{\text{CE}} = 5.0\text{ V}$ )<br>( $I_C = 10\text{ A}, V_{\text{CE}} = 5.0\text{ V}$ )   |  | hFE                  | 50<br>40 | 600<br>400        |
| Collector - Emitter Saturation Voltage<br>( $I_C = 10\text{ A}, I_B = 400\text{ mA}$ )<br>( $I_C = 20\text{ A}, I_B = 2.0\text{ A}$ )<br>( $I_C = 10\text{ A}, I_B = 400\text{ mA}, T_C = 100^\circ\text{C}$ ) |  | $V_{\text{CE(sat)}}$ |          | 1.9<br>3.0<br>2.0 |
| Base - Emitter Saturation Voltage<br>( $I_C = 10\text{ A}, I_B = 400\text{ mA}$ )<br>( $I_C = 10\text{ A}, I_B = 400\text{ mA}, T_C = 100^\circ\text{C}$ )   |  | $V_{\text{BE(sat)}}$ |          | 2.5<br>2.5        |
| Diode Forward Voltage<br>( $I_F = 10\text{ A}$ )   |  | $V_F$                |          | 5.0               |

**DYNAMIC CHARACTERISTICS**

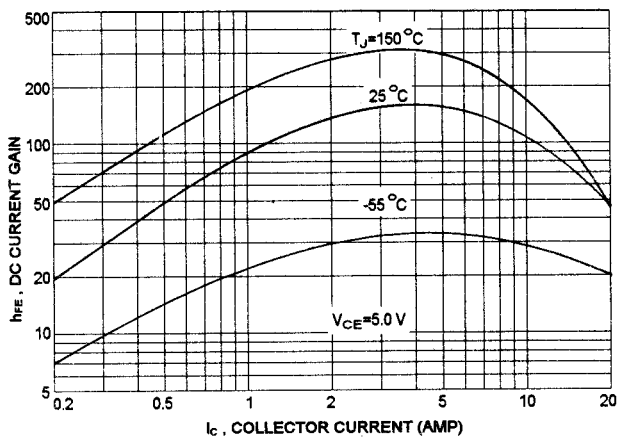
|   |  |            |     |    |
|---|--|------------|-----|----|
| Small-Signal Current Gain(2)<br>( $I_C = 1.0\text{ A}, V_{\text{CE}} = 10\text{ V}, f = 1.0\text{ MHz}$ ) |  | $ h_{fe} $ | 10  |    |
| Output Capacitance<br>( $V_{\text{CB}} = 10\text{ V}, I_E = 0, f = 100\text{ kHz}$ )                      |  | $C_{ob}$   | 100 | pF |

**SWITCHING CHARACTERISTICS**

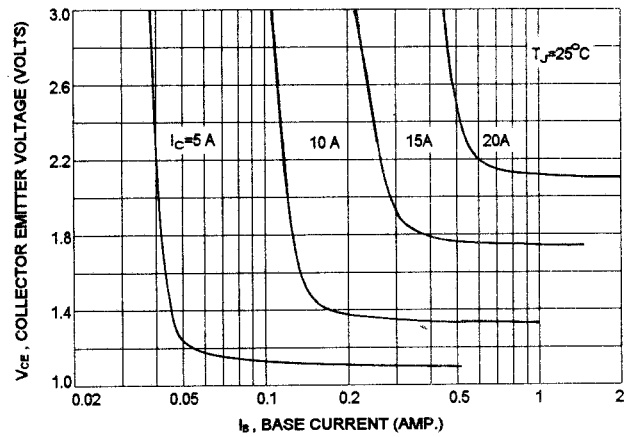
|              |   |       |     |    |
|--------------|---|-------|-----|----|
| Delay Time   | $V_{\text{CC}} = 250\text{ V}, I_C = 10\text{ A}$<br>$I_{\text{B1}} = 400\text{ mA}, V_{\text{BE(off)}} = 5.0\text{ V}$<br>$t_p = 50\text{ us}, \text{Duty Cycle} \leq 2\%$ | $t_d$ | 0.2 | us |
| Rise Time    |   | $t_r$ | 0.6 | us |
| Storage Time |   | $t_s$ | 1.5 | us |
| Fall Time    |   | $t_f$ | 0.5 | us |

(1) Pulse Test: Pulse width = 300 us , Duty Cycle  $\leq$  2.0%(2)  $f_T = |h_{fe}| \cdot f_{\text{test}}$

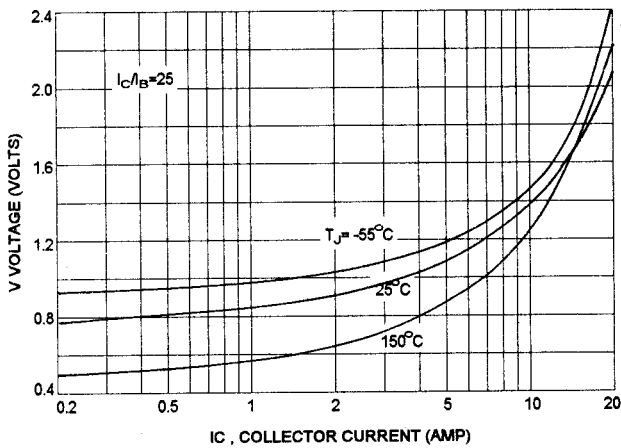
DC CURRENT GAIN



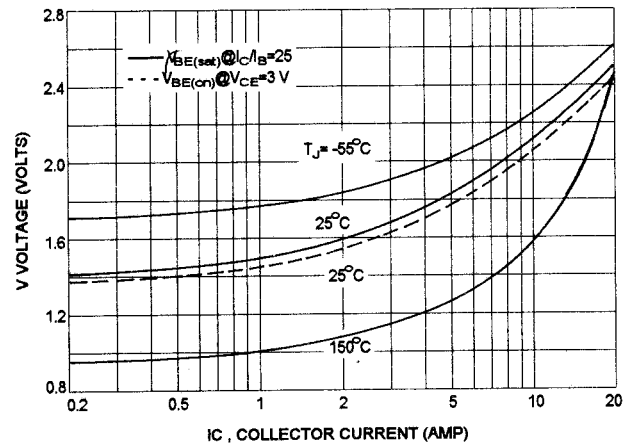
COLLECTOR SATURATION REGION



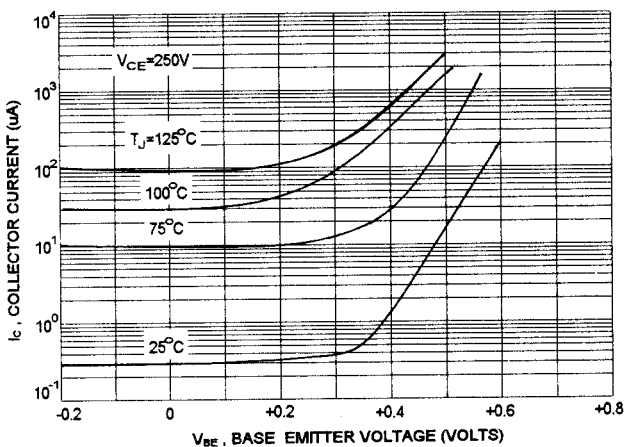
COLLECTOR EMITTER SATURATION VOLTAGE



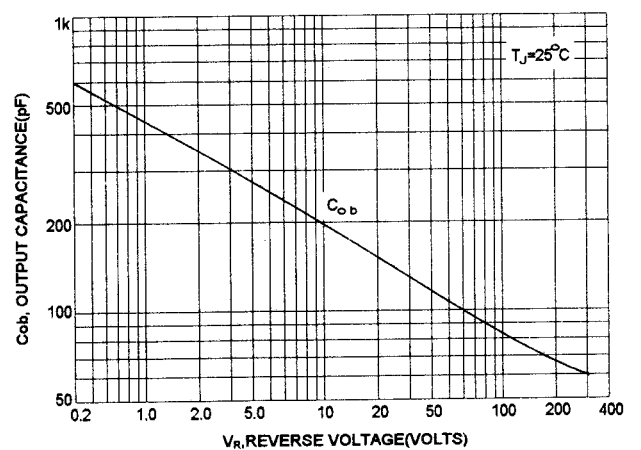
BASE EMITTER VOLTAGE



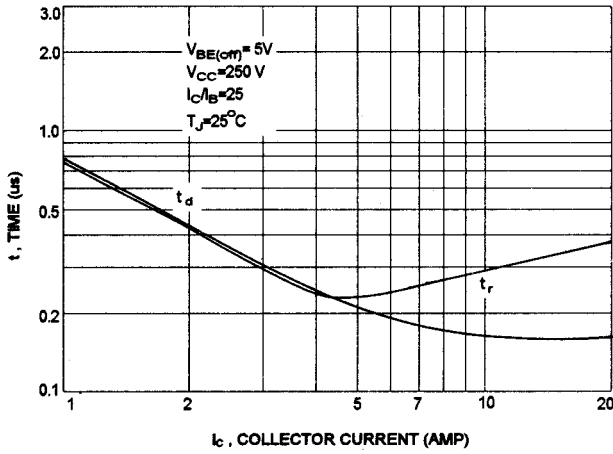
COLLECTOR CUT-OFF REGION



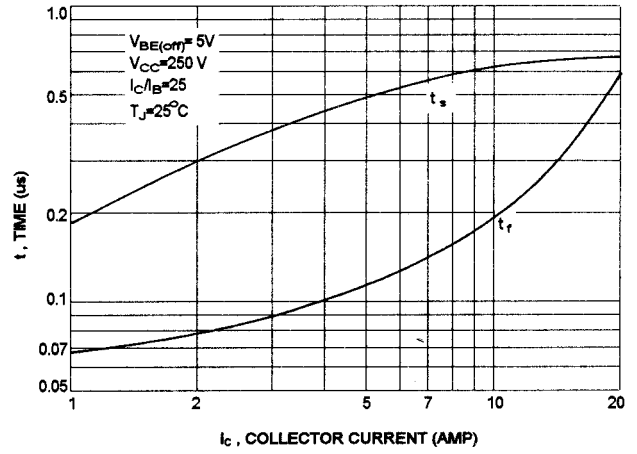
OUTPUT CAPACITANCES



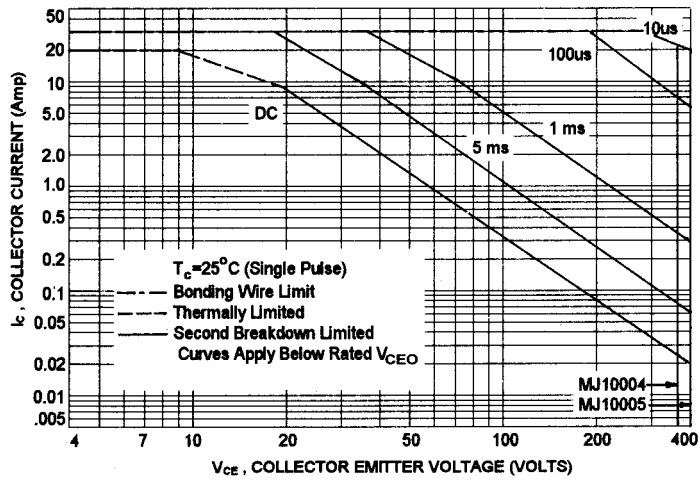
TURN-ON TIME



TURN-OFF TIME



ACTIVE REGION SAFE OPERATING AREA



REVERSE BIAS SWITCHING SAFE OPERATING AREA

